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# PATENT SPECIFICATION

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DRAWINGS ATTACHED

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## (54) IMPROVEMENTS IN OR RELATING TO STORAGE SYSTEMS

(71) We, CRISPLANT A/S, Bryggervej 21, Risskov, Denmark, a Danish Body Corporate, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to an article transferring and storing system including an external transferring system having a number of loading and unloading stations and a number of article carrier vehicles which are movable between these stations and operable to be loaded and unloaded, respectively, in these stations, and a storing system communicating with the external system so as to be operable to receive articles from the external system and cause the articles to be selectively transferred to a number of storing means such as shelves or cases placed in rows in two or more levels above each other, and to deliver articles to the external system by means of article carriers operating inside the store system.

Article transferring and storing systems of this kind are used e.g. in goods stations and air freight terminals, where incoming goods may be distributed from a goods receiving station to several delivery stations in accordance with the destinations of the different articles or pieces of goods. Often it becomes actual to store an article, e.g. for delivery to an air plane the following day, and normally therefore, the article carrying vehicles are movable to and from an article exchange position adjacent a store inside which the said article carrier or carriers operate the bringing of articles from the exchange position into the store as well as the bringing of stored articles back to the exchange position where the articles are loaded onto empty vehicles which then bring the articles to their destination delivery stations in the said external transferring

system. Especially when working with palletized goods the entire system may operate in an almost fully automatic manner.

In most known systems of this kind the store is built up as a row of tall store cases each having shelves or boxes open to both sides of the cases, these double-sided store cases being placed parallel to each other with a more or less narrow spacing or gangway therebetween. The floor in each gangway is provided with rails for a movable loader and unloader crane comprising a mast projecting up from a vehicle on said rails and a horizontally movable fork member mounted on a lift block which is vertically movable on the mast. The crane may be controlled manually or automatically so as to deliver goods into or collect goods from any of the boxes or shelves in the store cases at both sides to the gangway. One crane may be provided in each gangway, or a single crane may serve several gangways when connection rails are provided outside the store case system.

Goods to be stored are loaded on a pallet on a carrier vehicle in said loading station whereafter the vehicle is moved to a loading position for the crane, and in this position the crane picks up the pallet and moves it to the desired shelf in the store system, controlled by an operator seated on the lift block or by automatical means responsive to the setting of a destination code for each pallet according to any suitable coding system. The delivery of goods from the store is carried out in a corresponding, opposite manner.

The receiving and delivering capacity of such a store system is limited by the fact that the crane cannot handle more than one pallet at a time, so that all further work at least in one gangway is stopped as long as the crane is occupied with moving from the position in which goods are transferred between the crane and the said vehicles to

the selected store shelf (e.g. a high shelf at the other end of the gangway) and back again to the said transfer or exchange position. Also, the transfer of goods or pallets between the crane and the vehicles take some time. It would be possible to double the capacity by working with two cranes in each gangway, i.e. with transfer positions at both ends of the gangway, but the cranes are rather expensive, so in many cases the extra costs would be too high. Also separate loading and unloading carts might be used for serving the single levels of the store, but still the transfer of the pallets between the vehicles and the carts would take time, and especially in an automatic system constitute a source of possible faults.

It is the purpose of the invention to provide a store system in which the goods may be handled with highly increased capacity despite a simple construction of the system.

According to the invention there is provided a system of the type referred to in the opening paragraph, in which the store system communicates with the external system in such a direct manner that the said article carrier vehicles are movable directly into, inside, and out from the store in order to effect article transfer inside the store, article transfer means being provided for selectively transferring articles between the storing means and the carrier vehicles. It is obtained hereby that the articles to be stored or to be delivered from the store should not be released in any particular transfer or exchange position, since they may simply remain on the vehicles, and the vehicles are operative in the external system as well as inside the store system and between these systems. The store may be so adapted that there is one-way traffic along the shelf rows and generally inside the store, whereby the vehicles shall not wait for each other as far as the return movement of a foregoing vehicle is concerned.

The means for causing article exchange between the storing means and the vehicles may advantageously be constituted by pallet lifting and displacing means associated with the vehicles whereby it is avoided that such means should be provided in connection with each single storing means.

In the following the invention is described in more detail with reference to the accompanying drawing, in which:—

Fig. 1 is a top view of a store system according to an embodiment of the invention,

Fig. 2 is a schematic view thereof,

Fig. 3 is an end view thereof,

Fig. 4 is a perspective view of an embodiment of a vehicle for use in connection with the store system of figs. 1-3

Fig. 5 is an end view of a gangway shown with vehicles in different positions illustrating

the transfer of goods from the vehicles to the store shelves,

Fig. 6 is a perspective view of another embodiment of the store system, and

Fig. 7 is a schematic side view of still another embodiment thereof.

Fig 1-3 show a central store comprising two outer rows of shelf rooms 2 in three levels and a central double-sided open case divided in corresponding shelf rooms, gangways 4 and 6 being left between the cases. A railway system for a plurality of carrier carts is provided, comprising the following sections: An inlet section 8 guides the carts from the cart loading area and from a magazine for empty carts. This section continues in a section 10 leading to a section 12 which extends along the ends of the shelf cases in the lowermost level thereof and further to a section 14 extending through the gangway 4 at the bottom level thereof. Thereafter the railway continues in a section 16 round the end of the outer case, a section 18 extending rearwardly along the rearside of this case, a section 20 parallel with the section 12, and an outlet section 22 leading to an unloading area for the carts as well as to the said magazine for empty carts.

In the section 10 there is provided two switches to branched off sections 24 and 26 which, as most clearly seen in fig. 2 are formed as ramps leading to end sections above the section 12 and corresponding thereto, but extending in the intermediate and upper level, respectively. In all three levels these end sections 12 have a branched off section 28 extending through the gangway 6 in each of the levels, whereas all sections 12 continue in sections 14 through the gangway 4, one in each level. These sections 14 and 28, in each level, continue into a common section corresponding to the section 16 as described above; the sections 16 in the two upper levels, however, do not continue in sections corresponding to the low level section 18, but in sections 30 and 32, respectively, located laterally spaced from the vertical plane through the section 18 and formed as descent ramps merging into the lower section 18 from the side thereof; if necessary, these ramps may instead merge into the cross-section 20, as indicated in dotted lines, or even into the section 22 if the store is relatively very high.

It will be appreciated that with this rail system and a suitable rail switch control system (known per se in many different designs) it will be possible to guide a cart to a position in front of any selected shelf box in the store system. When the carts are provided with means for depositing goods such as a loaded pallet on a shelf and correspondingly for picking out goods from a shelf box, then it will be possible to use the store system in a fully automatic manner. Alter-

natively, the shelves may be provided with the necessary means for effecting the transfer of goods between the carts and the shelves. The carts may be driven in any suitable manner, but self-driving carts moving independently of each other are preferred for obtaining maximal expedition capacity of the system, not least when the transfer means are designed so as to require full stop of the particular cart during their operation; on the other hand, the system according to the invention is not necessarily restricted to this type of performance. It is a significant advantage of the system according to the invention that the carts running in the central store may be the same as those used in the external system, i.e. the common system including e.g. a plurality of unloading stations corresponding to different destinations of the goods on each of the carts. In a similar manner, the input line 8 may be considered as a common output line from an external railway system serving many loading stations.

Normally, of course, the store will comprise a high number of shelf cases, much higher than shown in the drawing.

As mentioned, an automatic control of the movements and operation of the carts in the store system is obtainable by means known in the art; each cart may be assigned a destination code in one of the variety of manners so as to automatically move to the desired destination in the store (as well as in the external circuit) and effect the transfer of goods in this position. Many carts may work in the store at one time, means known in the art being provided for preventing collisions at the rail junctions and during the stops of the carts.

An embodiment of a cart for use in the system is shown in figs. 4 and 5. It comprises a chassis 40 having a cross body 42 provided with dovetail grooves 44 holding a laterally movable slide 46 (shown as two spaced elements) carrying at the top thereof two transverse beams 48 projecting freely to both sides of the slide. Each beam 48 serves to telescopically hold a fork member 50 which is tube-formed with a longitudinal slot in the lower side thereof so that it may slide from side to side on the beam 48 past the slide 46. Suitable means (not shown) are provided for causing the slide 46 to move relatively to the slide. The cart is provided with an electric motor for driving it along the rails 52, energised preferably by means of contact shoes sliding along contact rails (not shown).

Also the fork moving means may be energised in this manner.

Furthermore, in a manner not shown, means are provided to raise and lower the fork member 50 relatively to the cart wheels 54, e.g. by raising and lowering the chassis 40 relatively to the wheel shafts.

The cross body 42 is provided with outer edge portions 56 adapted to engage underneath rigid edges 58 protruding from the shelves 60 in the store (see fig. 5), so as to prevent tilting of the cart. As shown in fig. 5 the rails 52 are carried on platforms or rods 62 bridging the gangway between opposed shelf cases in the store in each of the different levels thereof in such a manner that the fork members 50 are situated slightly above the level of the adjacent shelf 60.

In their normal position the fork members 50 as well as the slide 46 are centered on the cart, as indicated in the uppermost and lowermost section of fig. 5. For bringing goods to the store the cart may be provided with a loaded pallet 64 of the usual type, carried by the fork members 50. The cart is sent into the store, and in accordance with its destination code it hereby moves to the selected or desired shelf 60 where a code responsive device causes the car to stop, e.g. by causing its driving motor to be disconnected from the wheels and connected to the driving arrangement for the forks 50. Anyhow, when the cart has reached its destination the forks 50 are caused to move to the required side whereby they bring the pallet in over the selected shelf, see the situation in the middle level as shown in fig. 5. When this introduction of the pallet has taken place the forks are automatically caused to be lowered so as to deposit the pallet on the shelf, and thereafter the forks are moved back to their centered position, see the lower section of fig. 5, whereafter the cart is moved further towards the output line 22. During the unloading the edge 56 will hold the cart in its horizontal position.

Of course, loading of the carts from any of the shelves will be carried out by corresponding movements, the only difference being that the forks are introduced in lowered condition and retracted from the shelf box in raised condition. It will be understood that with the use of a standard type of pallets the vertical movability of the forks need not be very big.

The invention is not restricted to the use of pallets as supports for the goods. It will be possible to use grate bottoms in the boxes rather than unbroken shelves, and the carrier means of the carts may be a corresponding grate member which may be lifted or lowered through the box bottom in order to remove or deposit goods, respectively. Generally, any kind of suitable goods transfer arrangements may be used instead of the arrangement illustrated in connection with the rigid boxes. Also, for some applications it will be possible to store the vehicles themselves in the boxes 2.

In the system schematically shown in fig. 6 the ramps for guiding the carts up to the higher levels are avoided together with

the rigidly mounted railway sections at each level. In stead there is used one railway section 70 extending all the way through the passage 4, 6 between each pair of neighbouring cases each of these sections being suspended in hoist cables or chains 72 so as to be vertically displaceable between operative positions in the different levels by means of a hoist structure 74 driven by control means not shown of a hoist structure 74 driven by control means not shown. In the, lowermost level (or in any other level) the support section 70 matches with a stationary railway section 76 connected to the exterior system so that vehicles may be fed onto the movable section 70 from the section 76. These vehicles, of which some may be empty and some loaded, then move to their respective destination along the boxes 2 in the lower level and effect the desired transfer of articles in this level. Thereafter the support section 70 is lifted to the next level, in which also the programmed transfer of articles to and from the vehicles takes place, and so forth. When the last or uppermost level has been served the support 70 may be lowered to the initial position and the vehicles sent out therefrom, preferably through the opposite end of the suport. However, the vehicles may also leave the support in another level and thereafter drive down along a ramp to the level of the exterior rail system.

It will be appreciated that it is possible to control this system by means of a computer in such a manner that once a vehicle has delivered its load to a store box 2 the vehicle may thereafter - in another level or by driving to another position in the same level - be used for receiving articles from another box.

Another alternative to the inclined driving ramps used in fig. 1 is illustrated in fig. 7. Instead of the ramps there is provided an exterior lift arrangement at least at one end, but preferably at both ends of the passages 2 and 4, e.g. a pater noster arrangement 80. Hereby it is possible to lift the vehicles up to any of the levels and again down from the different levels. This may be done in connection with the permanent railway supports used in each level in fig. 1 or in connection with the vertically adjustable railway support used in fig. 6, since of course the computer can easily cause a transfer of a vehicle between any pater noster platform and the railway section 70 in any level thereof, or even during movement between two levels.

Still another alternative would be to divide the railway support 70 in sections which might be individually vertically displaceable from a common aligned position. The pater noster devices 80 may be stationary, or they

may be laterally displaceable whereby they can serve several passages between the store cases. Even the store cases may be laterally displaceable.

#### WHAT WE CLAIM IS:—

1. An article transferring and storing system including an external transferring system having a number of loading and unloading stations and a number of article carrier vehicles which are movable between these stations and operable to be loaded and unloaded, respectively, in these stations, and a storing system communicating with the external system so as to be operable to receive articles from the external system and cause the articles to be selectively transferred to a number of storing means such as shelves or cases placed in rows in two or more levels above each other, and to deliver articles to the external system by means of article carriers operating inside the store system, characterized in, that the store system communicates with the external system in such a direct manner that the said article carrier vehicles are movable directly into, inside and out from the store in order to effect article transfer inside the store, article transfer means being provided for selectively transferring articles between the storing means and the carrier vehicles.

2. An article transferring and storing system according to claim 1, in which the vehicles entering the store are driven in a unidirectional manner inside the store.

3. An article transferring and storing system according to claim 1 or 2, in which the store communicates with the external system through an input line in which the vehicles move unidirectionally towards the store and an output line in which the vehicles move unidirectionally from the store to the external system.

4. An article transferring and storing system according to claim 2 and 3, in which the input line communicates with a number of entrance ends of guiding tracks for guiding the vehicles along a selected row of storing means, while the opposed exit ends of these guiding tracks all communicate with said output line.

5. An article transferring and storing system according to claim 1, in which each of the vehicles is provided with means for raising and lowering an article exchange between the vehicle and the storing means

6. A system according to claim 1, in which a railway or another suitable drive support for the vehicles is permanently arranged along the storing means in each level, first vertical displacement means being provided for guiding or moving the vehicles arriving to a common inlet position from this position to the drive support in each selected level, and second vertical displacement means being provided for guiding or

moving the vehicles from the drive supports in the different levels to a common outlet position for the vehicles.

7. A system according to claim 6, in which the said vertical displacement means are constituted by inclined driving ramps.

8. A system according to claim 7, in which along said ramps power driven means are provided for engaging and driving the vehicles at least during upward movement of the vehicles.

9. A system according to claim 6, in which the vertical displacement means are constituted by power driven lift means such as an intermittently operating lift of the pater noster type.

10. A system according to claim 9, in which the lift is mounted so as to be horizontally displaceable between a common vehicle inlet or outlet position and a number of inlet or outlet positions adjacent the ends of horizontally spaced rows of columns of storing means.

11. A system according to claim 1, in which a railway or another suitable drive support for the vehicles is arranged along each row of columns of storing means, said drive support being vertically displaceable between a vehicle receiving or delivering ring position in one or more levels and an operative position in two or more mutually different levels in which the vehicles may move along the support to and from their

loading or unloading positions in front of the single selected storing shelves or cases.

12. A system according to claim 9 and 11, in which the said lift means are arranged so as to communicate with the said support in the several operative levels thereof or during its movement between these levels.

13. A system according to claim 11 or 12, in which the drive support is divided in sections, each of which are raisable and lowerable to and from a common aligned position.

14. A system according to any of the preceding claims, in which the single units of rows of columns of store cases are laterally displaceable as a whole.

15. A system according to any of the preceding claims, in which the vehicles are let into the store at one end and let out therefrom at the opposite end.

16. An article transferring and storage system substantially as herein described with reference to the accompanying drawings.

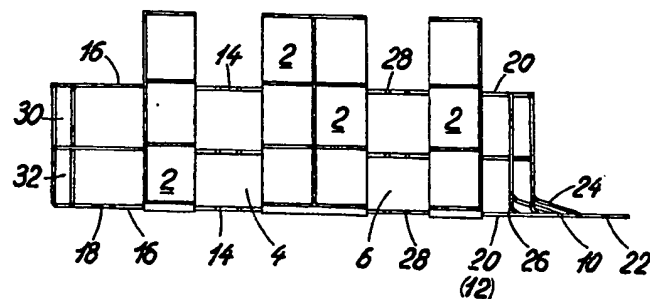
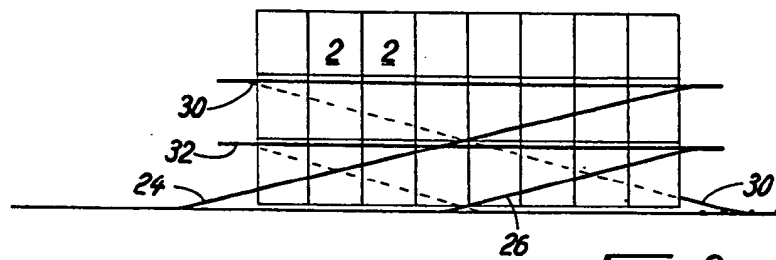
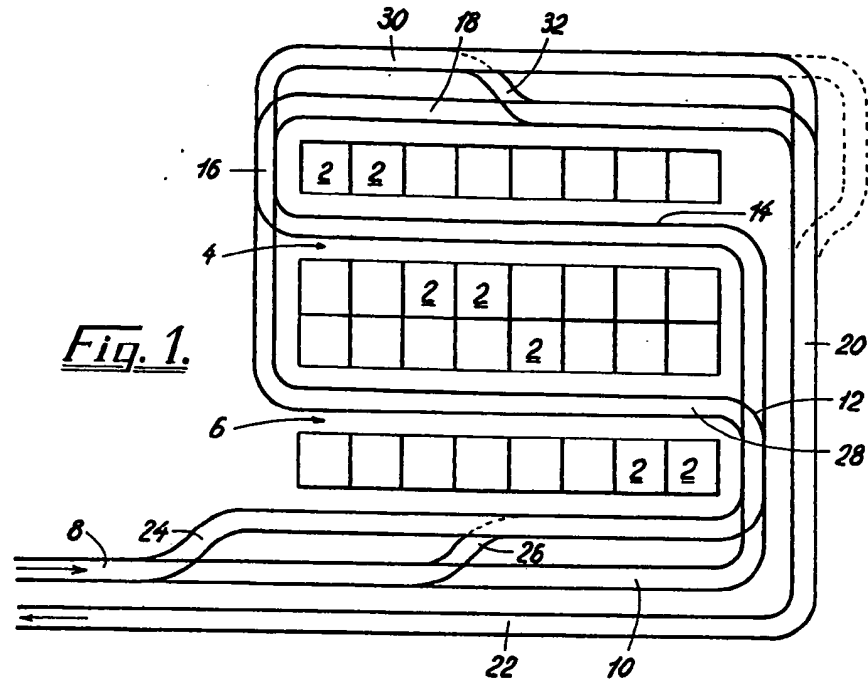
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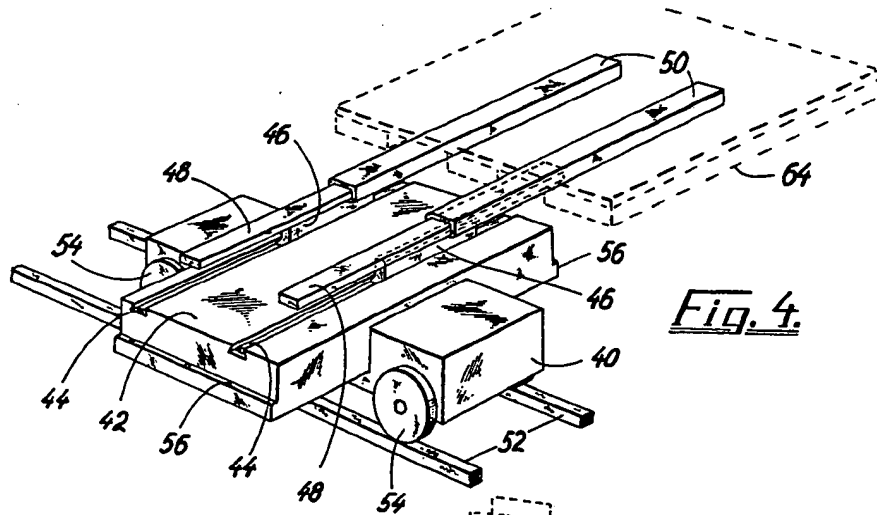


Fig. 4.

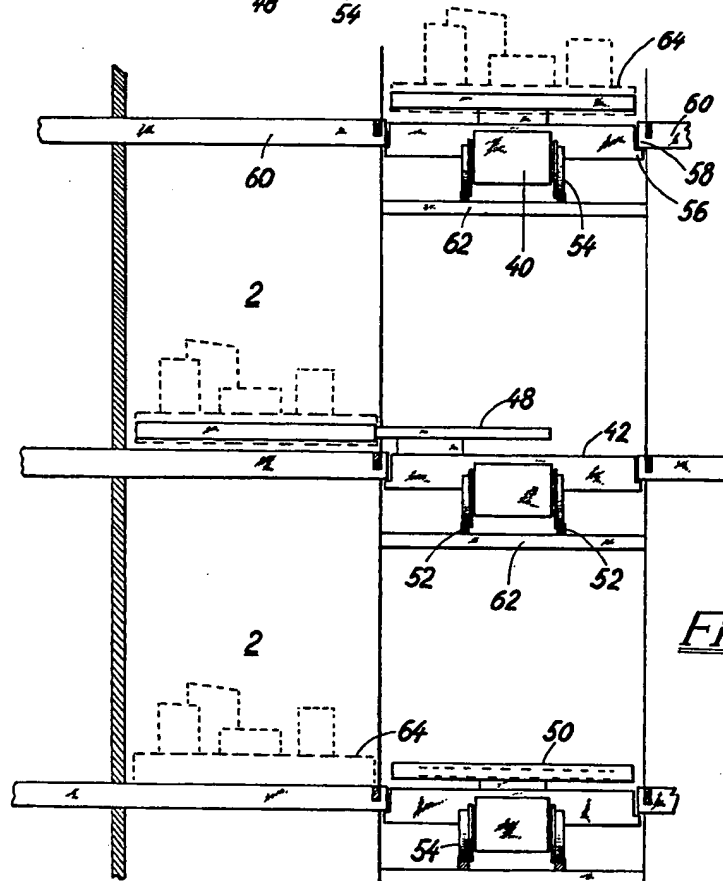


Fig. 5.

